SITE REASSESSMENT SUMMARY LETTER REPORT
CANADIAN RADIUM & URANIUM CORP.
KISCO AVENUE
VILLAGE OF MOUNT KISCO, WESTCHESTER COUNTY, NEW YORK

EPA ID No. NYD987001468

EPA Contract No.: EP-S8-13-01
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September 2017

Prepared for:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Prepared by:

Region 2 Site Assessment Team
Weston Solutions, Inc.
Edison, New Jersey 08837

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SUBMITTED BY:

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Date

Introduction

The United States Environmental Protection Agency (EPA) has tasked Weston Solutions, Inc. (WESTON®) Region 2 Site Assessment Team (SAT) with additional Site Reassessment activities to gather and evaluate new information on the Canadian Radium & Uranium Corp. (CRU) site in the Village of Mount Kisco, Westchester County, New York, and to determine whether further Superfund action is warranted. The Site Reassessment is assigned under EPA Contract EP-S8-13-01 (Region 8 Superfund Technical Assessment and Response Team IV [START IV]). In 2013 and 2014, Region 2 SAT conducted Site Reassessment activities that were focused on the surface water and air migration pathways; the Site Reassessment Report completed at that time and supporting documentation are incorporated here by reference (WESTON, 2014). Since that time, EPA Removal Assessment activities at the site have been conducted to further delineate the extent of contamination at the site and to evaluate on-site groundwater conditions.

The current Site Reassessment activities included collection of groundwater samples from off-site water-supply wells in December 2016 and June 2017, analysis of the samples for radiochemistry parameters, validation of the analytical results, evaluation and incorporation of the recent on-site Removal Assessment data and off-site Site Reassessment data, and re-evaluation of the ground water migration pathway. The work was conducted simultaneously with Removal Assessment activities being conducted by EPA. This Site Reassessment Summary Letter Report provides a description of the CRU site, a discussion of the investigative and remedial actions at the site, results of the Removal Assessment, results of the December 2016 and June 2017 supply-well sampling, and a hazard assessment including a Hazard Ranking System (HRS) site score.

Site Location and Physical Description

The CRU facility recovered uranium and other radioactive elements from uranium-bearing sludge and old instrumentation. The subject property is located to the east of Kisco Avenue and to the west of railroad tracks in the Village of Mount Kisco, Westchester County, New York, in an area that is primarily suburban residential and commercial. The current properties where CRU operated historically (i.e., "the subject property"), 103 and 105 Kisco Avenue from south to north with Railroad Avenue between, total 2.72 acres and are currently occupied by a landscaping business (103 Kisco Avenue) and a stone, masonry, and landscaping business (105 Kisco Avenue). The subject property is bounded by Kisco Avenue to the west, southwest, and northwest; railroad tracks to the south, east, and northeast; and a large, privately-owned warehouse to the north-northeast. The site location is shown in **Figure 1**.

The 103 Kisco Avenue property is partially paved and completely fenced with an access gate, which is closed and locked when employees are not on site. There is one small work trailer located at the northernmost portion of the property; the trailer includes a reception area, office, and employee break room. The property is used for parking trucks, forklifts, and other heavy machinery, and for staging roll-offs filled with debris and materials. Cement corrals for materials are also located on-site. Many areas are inaccessible for survey or sample collection activities due to the presence of obstructions such as wood piles, heavy machinery, and roll-offs. A manhole is located at the northeastern corner of the site.

At the 105 Kisco Avenue property, buildings, which were not part of the original CRU facility, consist of a main building for office and retail activities in the west-southwestern portion of the property and two warehouses in the northeastern portion of the property. There is a paved parking

area for customers in the southwestern portion of the property. The rear, eastern portion of the property is used for storage of surplus materials in corrals, separating different materials such as gravel, sand, wood chips, and other supplies. Materials and heavy machinery are present throughout the property.

Site History

From 1943 until sometime prior to 1966, the CRU facility operations in Mount Kisco included the recovery of uranium and other radioactive elements from uranium-bearing sludge, old instrumentation, and watch dials. The work began as part of the federal government's Manhattan Project. From 1943 to the 1950s, the primary product was uranium recovered from uranium-bearing sludge; subsequently, radium recovered from instruments and watch dials became the principal product until the facility's closure. New York State Department of Health (NYSDOH) has reported that the CRU facility also recovered radium-D (i.e., lead-210 [Pb-210]), radon, polonium, and actinium. In 1957, the plant manager died of leukemia and CRU pled guilty to charges of allowing three employees to be overexposed to radiation. Between March 1958 and sometime after May 1961, decontamination and disposal procedures were established for the CRU facility.

In November and December 1966, the facility buildings (a two-story concrete block building and two smaller one-story concrete block buildings) were decontaminated and demolished as part of urban renewal efforts in the area. In addition, radioactive surface soil was excavated for disposal. A post-operation survey conducted by Isotopes, Inc. identified two locations on the Haggerty Millwork wall, originally shared with the main CRU building that had been demolished, above specifications. One contaminated location was removed by chiseling out the masonry of the wall. The second was a result of tailings from a leaking waste drum, which CRU had apparently stored on the second floor fire escape; since contamination was relatively low and it was a load-bearing section, the area was sealed with 1 to 2 inches of mortar until radiation levels were considered acceptable. The waste material showing the highest radiation levels was identified during the decontamination activities and collected into a drum. The drum was removed from the site by Nuclear Diagnostic Laboratories of Peekskill, New York, for disposal at the West Valley low-level radioactive waste burial site. All other waste material was monitored, loaded, and hauled off-site for disposal in the Croton Point Sanitary Landfill in Croton-on-Hudson, New York.

According to the demolition and decontamination report, the Haggerty Millwork building was scheduled for demolition within a year after the demolition of the CRU buildings. Sanborn Maps and aerial photography show that, by 1971, the Haggerty Millwork building had been demolished and the newly-paved Railroad Avenue had been relocated to where the main CRU building once stood. The maps and aerial photography also show that there were no structures remaining on the 103 Kisco Avenue property, and that new buildings had been constructed on the 105 Kisco Avenue property and the facility was operating as a lumber yard.

Previous Investigations (1979-1998)

In April 1979, Westchester County Health Department (WCHD) performed a radiological survey at the site. Based on the survey, the highest dose rates (i.e., 0.35 to 0.42 millirem per hour [mrem/hr], compared to the background level of 0.015 mrem/hr) were found in a small portion of a fenced area east of the lumber yard (i.e., an area located adjacent to the railroad). All other elevated dose rates

were found in areas covered by soil and vegetative growth. A February 1980 memorandum described the WCHD investigation findings in more detail. The area in question was approximately 78 feet by 60 feet, enclosed by a chain-link fence, and located between the railroad tracks and a concrete-covered area. The most significant contaminated area was a strip 15 feet by 5 feet, containing two separate "hot spots". Elevated readings several times above background were reported for an area extending about 50 feet south from the chain-link fence. The memorandum stated that the origin of this contamination was unknown and that it had not been discovered in previous surveys.

In September 1993, the Bureau of Environmental Radiation Protection of the New York State Department of Health (NYSDOH) completed a survey of the CRU site. Indoor radon measurements collected in the office, showroom, and storage/sales floor area documented a maximum value of 9.8 picocuries per liter (pCi/L) and an average value of about 8.1 pCi/L. NYSDOH also identified two outdoor areas where presence of radioactive materials was indicated: 1) the back portion of 105 Kisco Avenue, and 2) the road that ran next to the railroad tracks and inside the fenced portion of 103 Kisco Avenue.

In 1994, an EPA Site Inspection (SI) was conducted at the site to measure radon levels, collect air and soil samples, and measure exposure rates. Elevated exposure rate measurements were observed on both the northern (10–700 microroentgens per hour [μR/hr]) and southern (10–240 μR/hr) portions of the site property. Radium-226 (Ra-226) concentrations in soil samples taken from the top 1.5 feet ranged from 3 to 150 picocuries per gram (pCi/g). All of the radon measurements were below EPA's guideline (i.e., 4 pCi/L) and the air samples collected at the site did not detect any suspension of radioactive contamination.

In July 1998, NYSDEC completed a radiological survey of the site properties. The 103 Kisco Avenue property was found to have contamination over one large unpaved area (about 4,000 to 5,000 ft^2) and a few smaller areas. The highest radium concentrations observed were a few hundred pCi/g and in the top foot of soil. Soil sampling completed near Railroad Avenue, where the CRU facility once stood, showed elevated radium a few feet below the surface. Sampling beneath the road surface was not performed. There was no documentation of shielding or other control measures implemented on the property, but the conditions suggested that the property had been recently paved with asphalt or other cover materials.

The survey of the 105 Kisco Avenue property indicated that radioactive materials were present under the parking lot, but no samples were taken beneath the asphalt. The highest concentration of radium at the site (about 6,000 pCi/g) was found just north of Railroad Avenue. A large part of the main outside storage area was reported to be contaminated with radium near the surface as well as within some soil profiles to depths of about 4 feet. Railroad Avenue showed count rates that were lower than background soils; NYSDEC attributed these results to shielding by the road surface material. NYSDEC reported that radiation doses to workers or visitors to the site as it was used at the time were not significant. The dose rate was highest in a small area just north of Railroad Avenue; the accumulated dose in this area was estimated to be small due to expected short exposure times. NYSDEC did not consider the site to be fully characterized at the completion of the survey.

Previous Site Reassessment Sampling (2013-2014)

In September 2013, Region 2 SAT performed an on-site reconnaissance and gamma survey of the former CRU property and other possible areas of contamination. Background readings taken north and northeast of the site in the right-of-way (ROW) area alongside Kisco Avenue showed background gamma radiation levels of approximately 7,500 counts per minute (cpm). There were three areas in the back portion of the 105 Kisco Avenue property, east of the historical CRU main building, where readings exceeded two times (2x) background. Region 2 SAT performed gamma screening the sheds and warehouses, but not inside the main building. There were no elevated readings on the 103 Kisco Avenue property, including the manhole at the northeastern corner of the property. Many areas on both properties were inaccessible for screening due to obstructions (e.g., piles, heavy machinery, roll-offs). Gamma screenings of Railroad Avenue and the ROW area bordering Railroad Avenue showed gamma readings ranging from background to 30,000 cpm, with the highest reading at the corner of the 105 Kisco Avenue property.

In November 2013, Region 2 SAT advanced eight boreholes to the depth of 10 feet at the site for gamma screening and soil sample collection. Gamma screening data was collected with a scintillation meter at 6-inch depth intervals vertically down each borehole, and soil samples were collected from the intervals within each borehole where the highest gamma levels were recorded. The samples were analyzed for gamma-emitting radioisotopes including Ra-226 and Ra-228, isotopic thorium, isotopic uranium, and Target Analyte List (TAL) metals including mercury.

Analytical results for the soil samples indicated that levels of uranium-238 (U-238) and U-234 were at background levels (0.4–0.8 pCi/g), whereas several samples exhibited significantly elevated levels of thorium-230 (Th-230) (4.6–83.3 pCi/g) and Ra-226 (15.4–135 pCi/g). All instances of elevated Th-230 levels correlated with elevated Ra-226 levels. The lack of equilibrium between the parent radioisotopes (i.e., U-238, U-234) and daughter radioisotopes (i.e., Th-230 and Ra-226) of the U-238 decay series suggests that the measurable residual contamination at the CRU site is from processed material (i.e., material from which uranium has been extracted) and not from uranium ore. All individual radioisotope levels for the Th-232 decay series (i.e., Th-232, Th-228, and Ra-228) were at background levels (0.6–1.2 pCi/g) and were observed to be in equilibrium in each sample. There was one sample location that exhibited greater than three times (3x) the highest background level of lead, and mercury concentrations exceeded 3x background at three locations.

During the November 2013 sampling event, Region 2 SAT collected air measurements with RAD7 radon/thoron detectors at potential source areas, downwind locations, and background locations upwind (north) of the site. The sample inlets were set 1 meter above the ground surface. Radon and thoron were measured hourly for one 4-hour period in the morning and one 3-hour period in the afternoon. There were no levels of radon that met the criterion for significance above background (i.e., 2 standard deviations [2σ] above the site-specific background level). One downwind thoron measurement met the criterion for significance above background; however, this elevated thoron concentration was not considered to be site-attributable because thoron is part of the Th-232 decay series that was shown to be at background levels and in equilibrium on the site. There were no other significant levels of thoron documented.

In May 2014, Region 2 SAT personnel collected six sediment samples (including one environmental duplicate sample) from five locations along the perennial drainage ditch and Kisco River Tributary 8

located east and downstream of the site. One background sample was collected upstream from the probable point of entry (PPE) and another background sample was collected from the tributary upstream of the confluence with the perennial drainage ditch. Analytical results show that there is an observed release of Ra-226, Pb-210, and elemental lead from the CRU site to the surface water pathway. Three samples from two locations in the perennial drainage ditch, including the PPE, exhibited concentrations of elemental lead that were greater than 3x the maximum background level. One of the locations also exhibited levels of Ra-226 and Pb-210 that were 2σ above the mean site-specific background levels. To evaluate attribution of the observed release to the site, the percentages of isotopic lead (Pb-204, Pb-206, Pb-207, and Pb-208) found at the sediment sample locations were compared to average natural abundances. Pb-206, an end product of Th-230 and Ra-226 decay, was slightly elevated (about 1.25–1.75%), whereas Pb-204, Pb-207, and Pb-208 were slightly depressed for all samples including background. The highest Pb-206 percentages were at locations closest to the site. The slightly elevated abundance of Pb-206 suggests that the observed release is at least partially attributable to the CRU site.

Removal Assessment (2015-2016)

In August 2015, EPA Region 2 Removal Branch and WESTON's Removal Support Team 3 (RST 3) began a Removal Assessment at the site, the adjacent railroad right-of-way (Metropolitan Transit Authority [MTA] milepost 136), and a background location (a strip mall at 145-159 Kisco Avenue). EPA and RST 3 conducted gamma surveys of occupied indoor spaces, outdoor areas, and soil sample locations; screening for specific radioisotopes with a portable radioisotope identification system; a survey with RAD7 radon/thoron detectors; radon sampling in occupied spaces of on-site properties; and soil sampling.

The gamma surveys showed above-background gamma readings in many areas of the site, including indoor spaces at 105 Kisco Avenue (i.e., the electrical room of the main building and the southeastern corner of Warehouse 2), outdoor areas, and soil sample locations. The highest readings (140,000 to 180,000 cpm) were observed at a soil sample location near the northwestern corner of Warehouse 2, and there were readings of 80,000 to 120,000 cpm at an area where bagged soil was being staged on the ground surface at 103 Kisco Avenue. According to the property tenant at the time, the bagged soils were from a previous 3-foot-deep trench for installation of an electrical line across Railroad Avenue (i.e., where the CRU main building once stood). Under EPA's recommendation, the tenant subsequently restaged the bagged soil into a portable storage container. The specific radioisotope survey identified Ra-226 in some areas, including near the bagged soil and in jarred soil samples from both properties. Radon and thoron were detected above background levels at nine of thirteen surveyed locations inside the 105 Kisco Avenue main building.

Radon sampling in regularly-occupied spaces of on-site buildings by a National Radon Proficiency Program (NRPP)-certified company showed concentrations as high as 19.5 pCi/L in the 105 Kisco Avenue main building, compared with the EPA Site-Specific Action Level (SSAL) of 4 pCi/L, as well as slightly elevated concentrations in the southeastern corner of Warehouse 2. All other locations showed normal radon levels below the EPA SSAL. A radon mitigation system was installed in the main building and, in October 2015, a post-remedial radon sampling event indicated normal levels of radon below the EPA SSAL for all radon canisters deployed in the main building.

The soil sampling activities included collection of 12 soil samples (including one field duplicate) at the site using direct-push technology and one soil sample from an expected background location using a posthole digger and shovel. Locations exhibiting elevated radioactivity (as previously measured) were selected for soil sampling. The soil samples were analyzed for TAL metals and mercury; isotopic thorium and isotopic uranium; and Ra-226 (21-day ingrowth), Ra-228, and other gamma-emitting radioisotopes. The radioisotope analytical results were compared with EPA SSALs, and the analytical results for TAL metals and mercury were compared with EPA Removal Management Levels (RMLs). Ra-226 was detected above its EPA SSAL (2.52 pCi/g) at seven soil sample locations, with the highest reading (an estimated 129 pCi/g) detected in a sample from a depth of 0 to 2 feet below ground surface (bgs) at 105 Kisco Avenue. No radioisotopes were detected above the EPA SSAL in soil samples collected from the background location.

During the August 2015 Removal Assessment event, EPA collected seven on-site wipe samples from locations biased toward floor cracks and entryways and one field blank wipe sample. The wipe samples were analyzed by EPA's Radiation Health Physicist (RHP) for the presence of radioactivity using a Ludlum-3030 meter. Alpha and beta counts for all the wipe samples were at the natural background level conservatively estimated by counting a blank wipe.

In April 2016, RST 3 and EPA conducted Removal Assessment Phase II, which included additional ground radiological surveys, as well as direct-push soil sampling at 19 locations throughout the site and at a new off-site background location, 123-135 Kisco Avenue. The radiological survey and soil sampling event was conducted to identify additional source areas and to assist in determining the extent of on-site radioactive contamination. The radiological survey was hindered by parked vehicles and supplies in outside storage areas at 103 Kisco Avenue and by the presence of large quantities of merchandise in outside storage areas throughout 105 Kisco Avenue (particularly the northeastern portion of the property). The radiological survey showed several on-site locations with gamma readings exceeding 2x background. At 103 Kisco Avenue, there were elevated gamma readings along the northeastern fence line (near the staging location of the bagged soil), along ROW areas to the northwest and north, and at the southern portion of Railroad Avenue. At 105 Kisco Avenue, elevated gamma readings were observed in the vicinity of Warehouse 2, in the northwestern portion of the property between merchandise storage areas, near the southern access gate next to the customer parking lot, at the southeastern corner of the perimeter fence, in the center of the customer parking lot, and near the western entrance to the main building.

During the April 2016 event, EPA used surface gamma screening results to select boring locations for soil sample collection; four on-site locations with elevated gamma readings, fifteen on-site locations with background gamma readings, and the off-site background location were selected. A drilling subcontractor advanced the borings and extracted soil cores to depths 4 to 8 feet bgs at the sampling locations, and RST 3 collected soil samples from every 12-inch interval of each core. Upon completion of each borehole and prior to backfilling, RST 3 conducted gamma screening at 6-inch intervals vertically down to the bottom of the hole; this subsurface borehole screening was conducted to determine the depth intervals with the highest gamma reading and to vertically delineate the extent of the radiological contamination.
RST 3 collected a total of 96 soil samples (including four field duplicates) from the 19 on-site soil borings, and seven soil samples (including one field duplicate) from the off-site background soil boring. The soil samples were spilt between two laboratories for analysis, Pace Analytical Services (PACE) and EPA's National Analytical Radiation Environmental Laboratory (NAREL); all the soil

samples were analyzed for isotopic thorium, isotopic uranium, Ra-226 (21-day ingrowth), Ra-228, and other gamma-emitting radioisotopes. Ra-226 was detected above the SSAL (2.52 pCi/g) in at least one 12-inch interval at all but two on-site locations and at the presumed background location. The on-site exceedances ranged from 2.57 pCi/g to 926.1 pCi/g, with the highest level in the 36- to 48-inch depth interval along the northern edge of Railroad Avenue; Pb-210 was detected above the EPA SSAL of 418 pCi/g in the same sample. Two locations, both located in the south-southeastern portion of 105 Kisco Avenue, showed Ra-226 exceedances in the 0- to 12-inch depth interval, and on-site exceedances extended as deep as 84 inches bgs. The off-site Ra-226 levels ranged from 0.61 pCi/g to 11.04 pCi/g, with the lowest level in the 72- to 84-inch depth interval and the highest level just beneath that in the 84- to 96-inch depth interval. Of the four on-site locations sampled beyond 48 inches bgs, none showed a Ra-226 exceedance in the 84- to 96-inch depth interval.

In June 2016, EPA and the Department of Energy (DOE) independently conducted aerial overflights of the site to determine the possibility of lateral spread of the radiation contamination. The DOE overflight indicated potential lateral spread to the west of the Site along Kisco Avenue. The EPA overflight indicated two other potential areas of interest, one located immediately southeast of the site at North Moger Avenue and the second located approximately 0.5 mile southwest of the site in the parking lot of Diplomat Towers (a residential condominium complex).

In December 2016, EPA and RST 3 conducted Removal Assessment Phase III, which included ground surface gamma screening at the potential areas of interest identified by the June 2016 aerial overflights. The gamma readings in these areas all were below 2x background. Phase III also included drilling and installation of three temporary wells at 105 Kisco Avenue. Groundwater was encountered at depths of approximately 4 feet bgs in all three temporary wells; groundwater elevations indicate that groundwater in the water-table aquifer flows north-northeast across the site, approximating the paths of Kisco Avenue to the west, the railroad tracks to the east, and Kisco River further east. The groundwater elevations show that the Phase II off-site location, where there is clean soil above contaminated soil and the contamination is below the water table, is hydraulically downgradient of the contaminated soil source at the site. This suggests that the Ra-226 contamination might have migrated to the off-site location via subsurface flow.

Groundwater samples were collected from the temporary wells and analyzed by PACE for the same parameters as the Phase II soil samples, plus gross alpha and gross beta. Duplicate samples TW-3-01 and TW-3-02 were collected from the location along the north side of Railroad Avenue that showed the highest soil levels of Ra-226 during Phase II. Sample TW-1-01 was collected in the northern portion of the site, downgradient of that soil hotspot. Sample TW-2-01, collected along the eastern edge of the property from an area that showed lower relative Ra-226 soil concentrations and in a sidegradient position, is evaluated as a background sample. The Ra-226 levels in samples TW-3-01 (45.8 pCi/L), TW-3-02 (315 pCi/L), and TW-1-01 (7.18 pCi/L) were significantly above the background level detected in sample TW-2-01 (estimated 0.92 pCi/L), constituting an observed release to on-site groundwater of a site-attributable contaminant.

Site Reassessment Water-Supply-Well Sampling

For the current Site Reassessment, Region 2 SAT conducted two rounds of groundwater sampling (December 2016 and June 2017) consisting of samples from six nearby water-supply wells, as described below. All six wells actively serve residential or worker populations and all were in

operation during both sampling events. The sampling efforts were conducted in support of the Canadian Radium & Uranium Corp. Site Reassessment assigned under EPA Contract EP-S8-13-01 (Region 8 START IV).

December 2016: On December 6, 2016, Region 2 SAT personnel collected a total of seven aqueous groundwater samples (including one environmental field duplicate) from six active water-supply wells located within or just beyond a 1-mile radius of the CRU site. Region 2 SAT collected the samples from two wells that serve a subdivision northwest of the site (sample 0428-WSW01 and duplicate samples 0428-WSW02/0428-WSW06); two wells that serve an apartment complex northeast of the site (samples 0428-WSW03 and 0428-WSW04); and two wells that serve professional buildings southeast of the site (samples 0428-WSW05 and 0428-WSW07).

The wells were purged for at least 15 minutes before sampling; two wells that had water holding tanks prior to sampling spigots (i.e., sample locations 0428-WSW05 and 0428-WSW07) each were purged for more than 30 minutes before sampling. Additionally, water quality was monitored during the purges at each well with a multiparameter water-quality meter, to confirm stable conditions. After purging at each well, raw groundwater samples (i.e., prior to water treatment) were collected directly into sample containers from the sampling spigots closest to the wellhead. Region 2 SAT also collected one sample with additional volume for laboratory Quality Assurance/Quality Control (QA/QC) purposes. Region 2 SAT logged sample locations electronically using Global Positioning System (GPS) equipment and performed post-processing differential correction of the GPS data. Sample location information is presented in **Table 1** and sample locations are shown in **Figures 2, 2A, 2B, and 2C**.

The December 2016 water-supply-well samples were shipped via FedEx to the NAREL laboratory in Montgomery, AL, where radiochemistry analyses were performed according to laboratory-specific analytical methods as shown in the table below:

Method SOP	**Revision / Effective Date**	**Parameters Reported**
AM/SOP-3: NAREL SOP for Gamma-Ray Spectrometry (GAM-01)	Revision 6 / April 26, 2016	Bismuth-212 (Bi-212) Bismuth-214 (Bi-214) Cesium-137 (Cs-137) Lead-210 (Pb-210) Lead-212 (Pb-212) Lead-214 (Pb-214) Potassium-40 (K-40) Radium-228 (Ra-228) Thallium-208 (Tl-208) Thorium-234 (Th-234)
AM/SOP-14: NAREL SOP for Radium-226 Analysis by Eichrom (RA226-EICHROM)	Revision 2 / April 4, 2016	Radium-226 (Ra-226)

Method SOP	Revision / Effective Date	Parameters Reported
AM/SOP-1: NAREL SOP for Actinides in Environmental Matrices by Extraction Chromatography (TH-EICHROM and U-EICHROM)	Revision 8 / November 30, 2016	Thorium-227 (Th-227) Thorium-228 (Th-228) Thorium-230 (Th-230) Thorium-232 (Th-232) Uranium-234 (U-234) Uranium-235 (U-235) Uranium-238 (U-238)
AM/SOP-4: NAREL SOP for Gross Alpha and Beta Analysis of Water Samples (GR-01)	Revision 6 / May 28, 2015	Gross Alpha Gross Beta

Complete sample analytical results for the December 2016 water-supply-well sampling effort are presented in **Table 2**. The results for samples 0428-WSW03 and 0428-WSW04 are considered to represent background levels because they were collected in a sidegradient direction from the site at a farther distance than other samples. For radionuclides that are attributable to a site but also occur naturally, including Ra-226 and other site-related contaminants, the criteria for establishing an observed release by chemical analysis are:

- The result exceeds the minimum detectable concentration (MDC); and
- The result equals or exceeds a value 2σ above the mean site-specific background concentration.

The December 2016 analytical results suggested the possibility of an observed release to two of the sampled target wells. The Ra-226 concentrations in samples 0428-WSW01 (1.07 J [estimated] pCi/L) and 0428-WSW02 (1.14 J pCi/L) exhibited elevated concentrations compared to the mean site-specific background plus 2σ value (i.e., 0.88 pCi/L). The reported levels of gross beta in samples 0428-WSW01 and 0428-WSW02 and the estimated levels of Bi-214 and Pb-214 (daughter products of Ra-226) in sample 0428-WSW01 were also elevated above background. Based on results from previous investigations, Ra-226 is attributable to the site; in turn, its daughter products Bi-214 and Pb-214 are also considered to be site-attributable.

The reported levels of U-234 and U-238 in samples 0428-WSW02, field duplicate 0428-WSW06, 0428-WSW-05, and 0428-WSW-07 appeared to be elevated above background; however, U-234 and U-238 have not been detected significantly above background in on-site soil or groundwater samples and are not considered to be site-attributable. All analytical results reported for the thorium-232 decay series (Th-232, Th-228, Ra-228, and Pb-212) did not meet the criteria for significance above background levels and are therefore considered to be at background levels.

As indicated above and in **Table 2**, the Ra-226, Bi-214, and Pb-214 results that suggest a possible site-attributable release were considered to be estimated values. In addition, radiochemistry results are reported with associated levels of uncertainty. Although the December 2016 results suggested a possible observed release to nearby target wells, none of the results was high enough to overwhelm the associated uncertainty. Therefore, EPA decided to collect confirmatory samples from the wells in June 2017 to re-evaluate the observed release, as discussed below.

June 2017: On June 27 and 28, 2017, Region 2 SAT personnel collected confirmatory samples from the same water supply wells that had been sampled in December 2016. Each sample number was designated with a "-2" suffix to indicate Phase 2 sampling (i.e., resampling) at these locations. Region 2 SAT collected a total of seven water supply well samples (including one environmental field duplicate) using the same well purging and sampling procedures as in December 2016. Region 2 SAT also collected one sample with additional volume (i.e., 0428-WSW07-2) for QA/QC purposes. The samples were shipped via FedEx to the PACE laboratory in Greensburg, PA, where radiochemistry and total potassium analyses were performed according to standard analytical methods as shown in the table below:

Method and Description	**Parameters Reported**
EPA 200.7 Metals, Total	Total Potassium
SM7500RnB-07 Radon	Radon
EPA 900.0 Gross Alpha/Beta	Gross Alpha Gross Beta
EPA 903.1 Radium-226	Radium-226 (Ra-226)
EPA 904.0 Radium-228	Radium-228 (Ra-228)
ASTM Method D5174-97 Total Uranium KPA	Total Uranium
HSL-300(AS) Actinides	Uranium-234 (U-234) Uranium-235 (U-235) Uranium-238 (U-238)

Complete sample analytical results for the June 2017 Phase 2 water-supply-well sampling effort are presented in **Table 3**. For the Phase 2 results, observed release is evaluated according to the same criteria and background locations as the previous results; therefore, samples 0428-WSW03-2 and 0428-WSW04-2 are considered to represent background levels.

The Phase 2 sampling results indicate that no observed release of site contaminants to target wells has occurred. The only parameter reported at a level elevated above background for sample locations 0428-WSW01 and 0428-WSW02 was U-238 in sample 0428-WSW01-2; however, U-238 is not considered to be site-attributable. For samples 0428-WSW05-2 and 0428-WSW07-2, several parameters were reported above background: total uranium, U-234, U-238, and radon in both samples, as well as total potassium, Ra-228, gross alpha, and gross beta in sample 0428-WSW05-2. The elevated concentrations at those wells are not considered to be site-attributable because they are not source contaminants and the wells are not located downgradient of the site. The elevated levels of uranium isotopes shown by both rounds of sampling are believed to be naturally-occurring – despite the history of uranium processing at the CRU site, on-site soil and groundwater sampling has not identified uranium or uranium isotopes as contaminants of concern. The elevated radon in samples 0428-WSW05-2 and 0428-WSW07-2 is evaluated as a naturally-occurring daughter product of the uranium isotopes that are present. There were no exceedances of maximum contaminant levels (MCL) during either round of sampling.

Current Hazard Assessment

Based on the background information regarding site history and conditions, as well as results of the Site Reassessment and Removal Assessment investigations, residual contamination is known to exist in subsurface soils at the site. Observed releases are documented in the ground water and surface water migration pathways, but actual contamination is not documented for targets in either pathway.

Sources

The previous site reassessment sampling and the ongoing Removal Assessment show that there is a contaminated soil source at the site. The site was historically a uranium and radium extraction facility functioning from 1943 until sometime prior to 1966. Until the 1950s, the facility's main product was uranium recovered from uranium-bearing sludge. From the 1950s until closure, the main product was radium recovered from instruments and watch dials. It has been reported that lead-210, radon, polonium, and actinium were also recovered at the facility.

As described previously, the CRU facility buildings were decontaminated and demolished in the 1960s, some radioactive surface soil to a depth of 1 foot was excavated during the demolition, and the radioactive waste materials were removed from the site for disposal. Significant physical changes to the subject property, including the relocation and construction of Railroad Avenue where the main CRU building once stood and the construction of new buildings, occurred between 1966 and 1971. Several investigations since 1979 have indicated the presence of residual contamination at the site. As described previously, the radiation surveys and soil sampling completed by Region 2 SAT and RST 3 confirm the presence of residual contamination.

The hazardous substances detected in the contaminated soil source and attributable to historical operations include Th-230, Ra-226, and Pb-210; these radioisotopes are all part of the U-238 decay series. The uranium isotopes in that decay series (U-238 and U-234) have not been detected at elevated concentrations in the contaminated soil, suggesting that the measureable residual contamination is from processed material and not from uranium ore. The contaminated soil is present at or near the ground surface in some locations, and extends to depths as great as 7 feet bgs. The total volume of contaminated soil is unknown.

Ground Water Migration Pathway

As described previously, groundwater samples collected during the Removal Assessment activities indicate an on-site observed release to shallow groundwater. However, the Site Reassessment sampling results do not confirm an observed release to nearby water-supply-wells (see **Site Reassessment Water-Supply-Well Sampling**), and there is not documented actual contamination of any target wells.

The aquifer being evaluated consists of the hydraulically-interconnected unconsolidated and bedrock units that underlie the CRU site. The site is underlain by unconsolidated sands and gravels of glacial outwash origin. The glacial deposits lie within a northeast-southwest trending valley defined by a syncline in the underlying bedrock, with the centerline of the valley roughly coinciding with the axis of the syncline. The bedrock consists of a narrow band of Manhattan Schist beneath the valley, but the valley walls and surrounding uplands are underlain almost entirely by Fordham Gneiss, the

predominant bedrock unit within the target distance limit (TDL). The CRU site itself is underlain by Fordham Gneiss at the edge of the contact with Manhattan Schist. The bedrock contains water-bearing fractures; the most extensive bedrock fracturing occurs in the first 100 to 150 feet bgs. There are numerous bedrock outcrops in the area, but bedrock is generally covered by till or outwash ranging in thickness from a few feet to 200 feet.

Within the target distance limit, the bedrock is hydraulically connected with the overlying unconsolidated deposits. Water levels recorded at any well that taps unconsolidated material likely reflect seasonal and annual water level trends in the bedrock. Sand and gravel deposits have moderate to high permeability in the range of 10^{-4} centimeters per second (cm/s) to 10^{-2} cm/s. USGS has calculated hydraulic conductivity of the bedrock in northern Westchester County to range from about 10^{-5} cm/s to 10^{-4} cm/s. Hydraulic conductivity of the bedrock varies with depth, but it is not closely related to the bedrock composition; topographic setting is the major factor in the distribution of hydraulic conductivity. The primary source of aquifer recharge is precipitation that infiltrates to the saturated zone. Mount Kisco receives approximately 45 inches of precipitation per year, and the net precipitation is greater than 30 inches per year. Groundwater flow is generally downward near hilltops and ridges and upward toward nearby streams and rivers. Water-table and artesian conditions occur in both unconsolidated deposits and bedrock.

Depth to water within the unconsolidated deposits at the site was approximately 4 feet bgs in December 2016; the depth of soil contamination at the site extends to 7 feet bgs. There is no dominant regional flow direction, but the general flow of groundwater is from hilltops toward nearby streams and reservoirs. Groundwater flow direction across the site is north-northeast. Due to the presence of the New Croton Reservoir approximately 2 miles northwest, overall groundwater flow is expected to be northwesterly. In areas that are supported by water supply wells and also have community sewering such as Mount Kisco, the sewers prevent water pumped from the aquifer from being returned to the groundwater system. The pumpage coupled with reduced recharge can cause groundwater levels to decline, and can influence groundwater flow direction.

Targets Associated with the Ground Water Migration Pathway

The largest groundwater supplies in Westchester County are obtained from sand and gravel, but the lateral extent of such deposits is limited. Water in usable quantities generally can be obtained anywhere in Westchester County from wells penetrating the bedrock. Historically, groundwater supplies in Westchester County have come from shallow wells (i.e., < 60 feet) in the sand and gravel or deeper wells in the bedrock; a majority of supply wells in the county withdraw water from bedrock. The Fordham Gneiss is the principal bedrock unit that underlies the site and surroundings, and it is the principal water-bearing material for wells within the 4-mile radius.

There are 42 active water-supply wells within the 4-mile TDL for the CRU site. The wells are associated with Community, Non-transient non-community (NTNC), and Transient non-community (TNC) water systems. Community water systems provide drinking water for residential populations, NTNC systems typically provide drinking water for institutions such as schools and worker populations, and TNC systems typically provide water supply to establishments that serve transient populations, such as restaurants and rest areas. The three categories of wells are evaluated as follows: non-transient populations served by Community

and NTNC water systems are evaluated as target populations, whereas transient populations associated with TNC systems are not considered as target populations.

The groundwater samples collected by Region 2 SAT in December 2016 and June 2017 were from the nearest Community and NTNC supply wells, all located within approximately 1 mile of the site; as discussed previously, the analytical results for the samples do not meet observed release criteria. Therefore, actual contamination is not documented and all target populations, including those served by the sampled wells, are considered as subject to potential contamination. The nearest wells are located approximately 0.51 mile north-northwest of the site (i.e., in a downgradient direction). The groundwater population considered as subject to potential contamination within the 4-mile TDL is approximately 7,420; the associated distance-weighted population value is 1,155.

Surface Water Migration Pathway

As described previously, the May 2014 sediment sampling documents an observed release to surface water of site-attributable contaminants by chemical analysis, Site runoff drains toward the northern and eastern portions of the site. Runoff of the site enters on-site storm drains and flows to the storm water pipe located along Kisco Avenue, which abuts the site to the west. The storm water pipe runs northeast from the site along Kisco Avenue, turns east and crosses beneath a parking lot and railroad tracks, and discharges to a perennial drainage ditch through an outfall located approximately 1,000 linear feet from the site. The outfall location is considered as the probable point of entry (PPE) to surface water. The documented observed release was limited to this perennial drainage ditch at and downstream of the PPE. A possible secondary runoff route would flow east onto the railroad ROW that abuts the site, and ultimately enter the perennial drainage ditch through overland flow. The perennial drainage ditch flows for approximately 0.2 mile from the PPE before discharging into Tributary 8 of the Kisco River. The in-water segment then continues for 0.9 mile along Tributary 8 until it meets the Kisco River, which flows northerly for 3.1 miles and discharges into New Croton Reservoir (part of Croton River). The New Croton Dam lies 6.3 miles downstream of the mouth of the Kisco River, at which point the in-water segment continues within the Croton River for 3.4 miles until it reaches Croton Bay. Croton Bay extends for 1 mile, where it meets the Hudson River. The in-water segment ends in the Hudson River 0.3 mile downstream from Croton Bay. The CRU site lies within the Croton Watershed.

Targets Associated with the Surface Water Migration Pathway

One surface water intake is located along the 15-mile surface water pathway for the CRU site within the New Croton Reservoir. The New Croton Reservoir intake is approximately 10.2 miles downstream of the PPE, with a flow of 15,000 cubic feet per second (cfs); the intake serves approximately 831,000 people. There are available areas where fishing is allowed, including: the Kisco River (moderate stream), New Croton Reservoir (large river), Croton River (large stream), and Croton Bay (river). There are approximately 5.96 miles of HRS-eligible wetlands along the surface water pathway. The Federal Emergency Management Agency (FEMA) has designated the site property to be in an area of minimal flooding.

Soil Exposure and Subsurface Intrusion Pathway

Soil contamination at the site is reported in historical surveys and it is confirmed by the investigations conducted by Region 2 SAT and RST 3 since 2013, as described previously. The available data from these investigations show that the contaminated soil is located across a large area beneath the site and to depths as great as 7 feet bgs. The site is mostly paved and enclosed with a maintained fence (i.e., stopping public access), as well as the presence of layers of asphalt and concrete over the contaminated soil. Some areas of observed contamination are paved, while others are unpaved; some areas of observed contamination are low-traffic areas used or traversed intermittently by on-site workers and not known to be used by the public. At least one source area is unpaved, located outside the fence, and accessible to the public.

Targets Associated with the Soil Exposure Pathway

The site is situated in a mixed commercial and residential area. There are eight residences within 200 feet of the site property, housing an estimated 22 people, however, no residences, schools, or day care centers are located on the properties where observed contamination is documented. There are approximately ten workers at New York Stone and Masonry Supply (105 Kisco Avenue). There are four to fifteen workers, depending on work load and season, at Hickory Homes and Properties, Inc. (103 Kisco Avenue). Approximately 9,047 people reside within 1 mile of the CRU site. There are no known terrestrial sensitive environments located on or within 200 feet of the site property.

Air Migration Pathway

A contaminant release from the facility to the ambient air is not observed. Although the presence of thoron at a slightly elevated level was documented during the November 2013 air monitoring event at the CRU site (as described previously), it is not considered to be attributable to site activities because the Th-232 decay series isotopes exhibited background levels and equilibrium in soil samples from the site. In addition, the 1994 EPA investigation did not indicate a release of contaminants from the site to the air. Radon measurements were taken from within the hardware store and outdoor storage shed. The results ranged from 1.0 pCi/L to 2.2 pCi/L which are below the EPA guideline of 4.0 pCi/L. A total of six air samples were collected from the property north and south of Railroad Avenue. Analysis of the samples for total alpha particle concentration indicated that all of the samples had less than the minimal detectable activity of $1x10^{-12}$ $\mu R/cm^3$. During previous reconnaissance and sampling activities, small amounts of dust generated by moving vehicles have been observed rising from the site.

Targets Associated with the Air Migration Pathway

Approximately 1,448 people reside within 0.25 mile of the site and a total of approximately 36,997 people reside within 4 miles of the site. There are approximately 1,129 acres of HRS-eligible wetlands within 4 miles of the site. According to NYSDEC, there is one state-listed threatened species habitat within 4 miles of the site.

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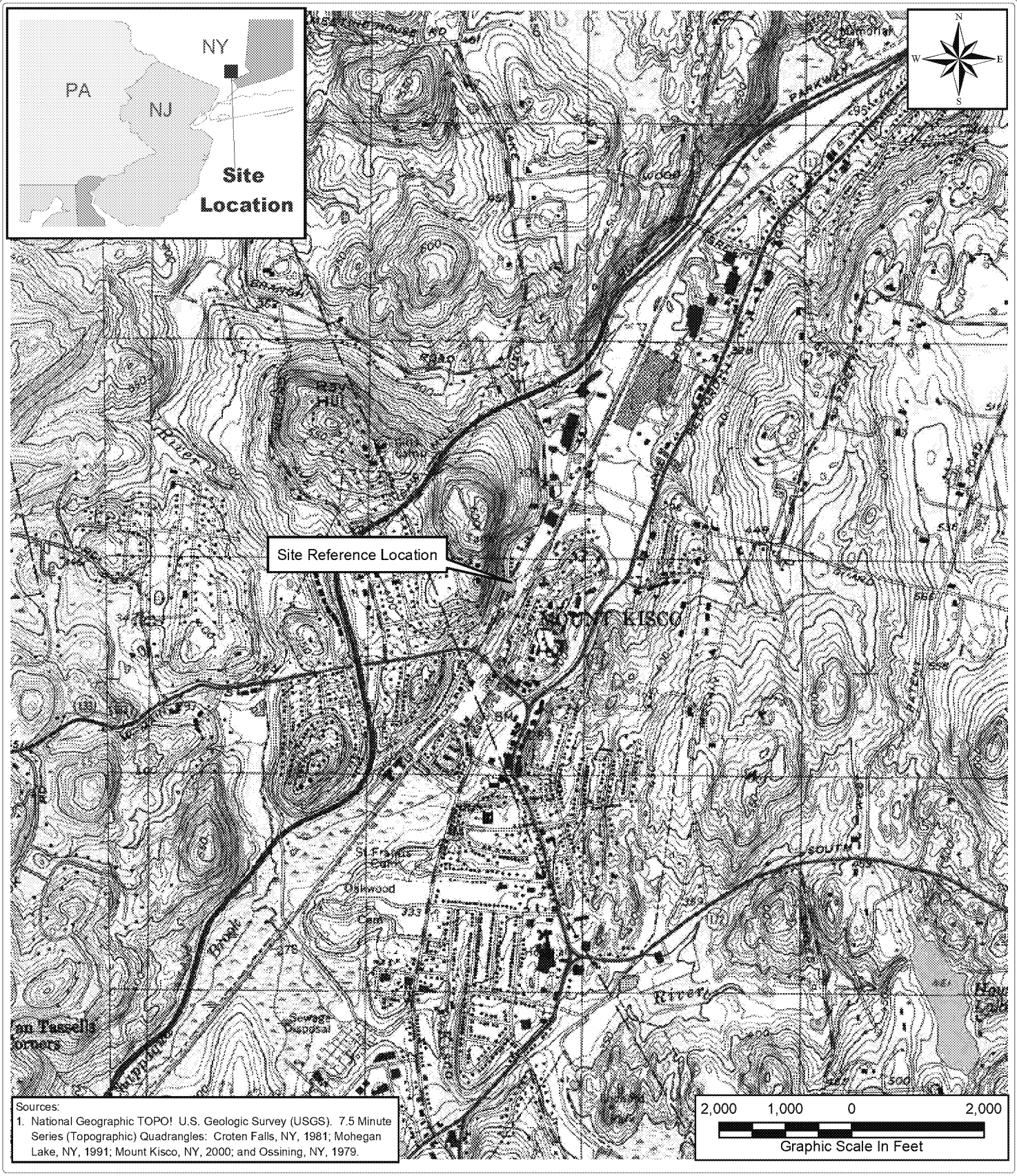
FIGURES



LEGEND:

Site Reference Location

TITLE:

Site Location Map
Canadian Radium & Uranium Corp.
Mount Kisco, NY

PROJECT:
Canadian Radium & Uranium Corp.
TDD No. 0004/1611-05

CLIENT NAME:
EPA

WESTON SOLUTIONS

DATE:
September 2017

FIGURE #:
1

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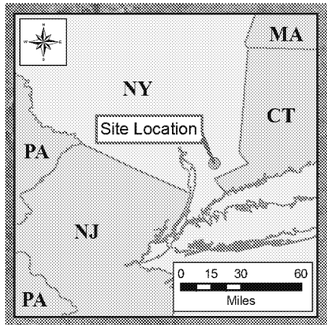

0428-WSW01
0428-WSW02
0428-WSW06 Duplicate
0428-WSW03
0428-WSW04
Site Reference Location
1/4 Mile
1/2 Mile
1 Mile
0428-WSW05
0428-WSW07

Legend

- Site Reference Point
- Active Community Well Sample Location(2)
- Active Non-Transient Non-Community Well Sample Location(2)

SOURCES:
1. Westchester County High Resolution Orthoimage 2013, Sai Pinnepalli, IIC Technologies, Inc, Manager, GIS Services, April 2013.
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SCALE: 1,260 630 0 1,260 Graphic Scale in Feet

PROJECT: Canadian Radium & Uranium Corp. TDD No. 0004/1611-05

CLIENT NAME: EPA

TITLE: Sample Location Map - December 6, 2016 Water Supply Well Sampling Site Reassessment Canadian Radium & Uranium Corp.

WESTON SOLUTIONS SM

DATE: September 2017

FIGURE #: 2

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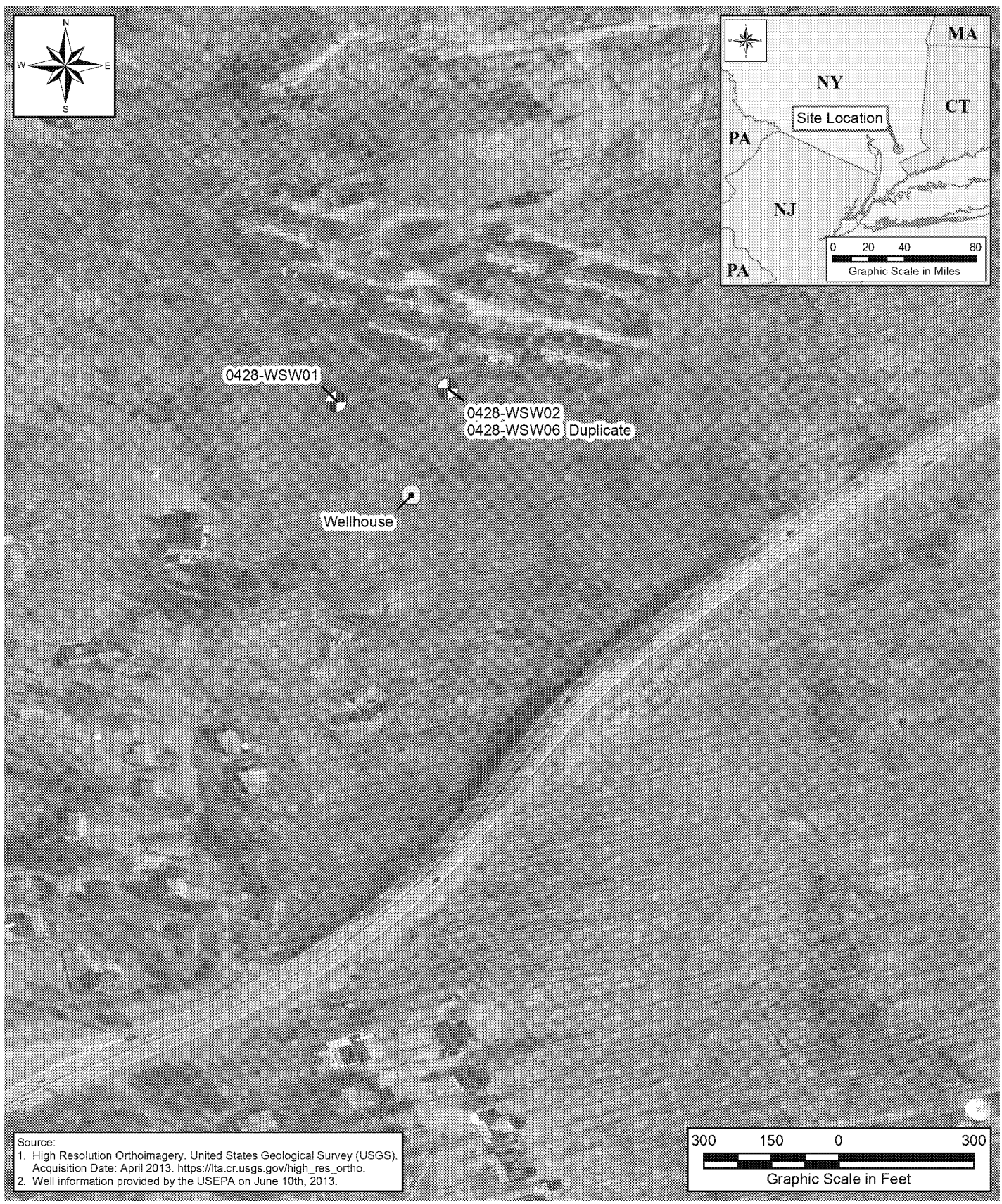


LEGEND:

- Wellhouse Location
- Active Community Well Sample Location(2)

PROJECT: Canadian Radium & Uranium Corp.
TDD No. 0004/1611-05

CLIENT NAME: EPA

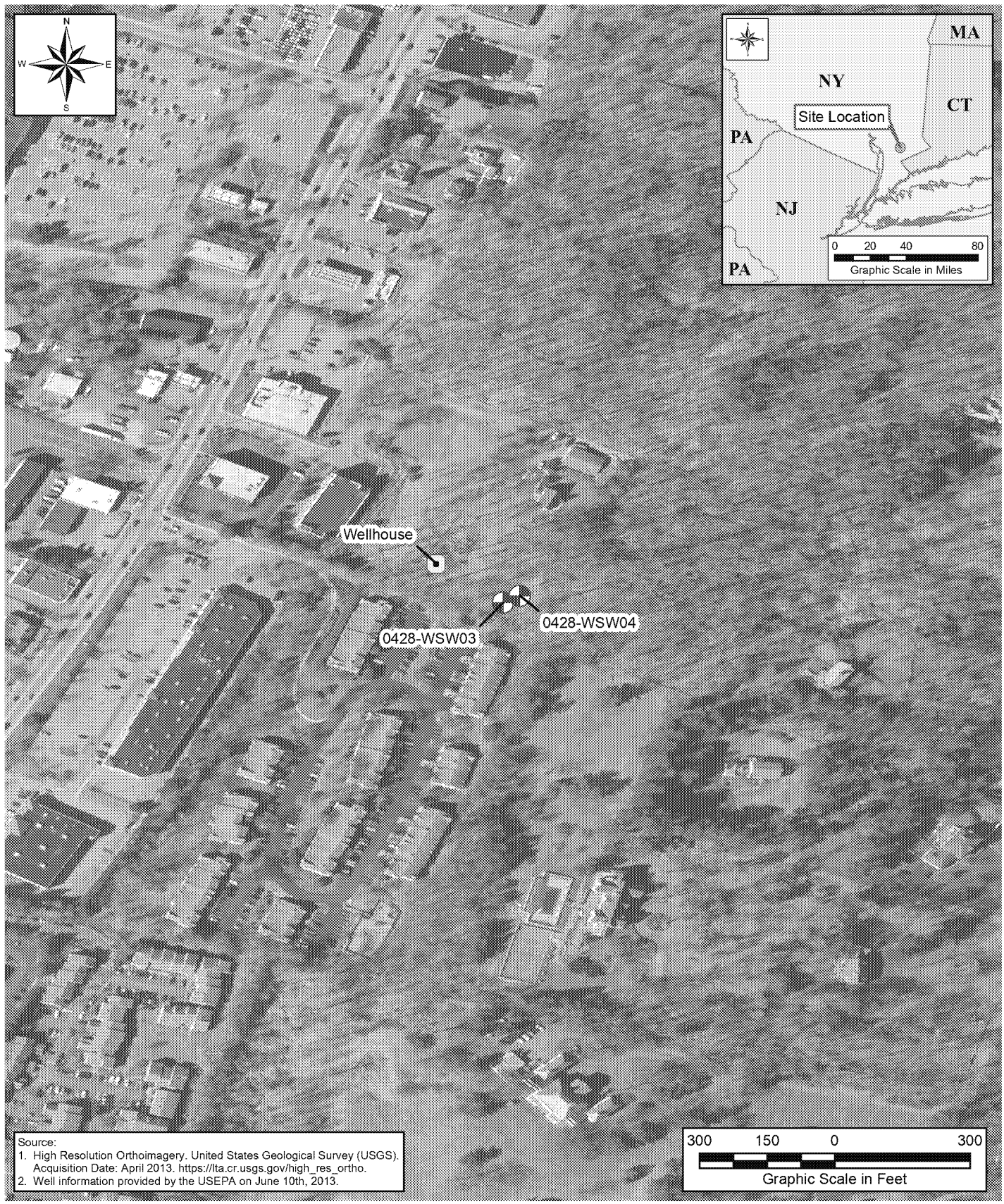
TITLE:

Sample Location Map
Ramleh Water Works Corp. Inc.
Site Reassessment
Canadian Radium & Uranium Corp.

DATE: September 2017

FIGURE #: 2A

P:\SAT2\2016 NY RAD Sites\Canadian_Radium_Uranium\MXD\19129_CRU_Sample_Loc_Fig_2A.mxd



LEGEND:

- Wellhouse Location
- Active Community Well Sample Location[2]

TITLE:

Sample Location Map
796 Bedford Road Apartments
Site Reassessment
Canadian Radium & Uranium Corp.

PROJECT: Canadian Radium & Uranium Corp.
TDD No. 0004/1611-05

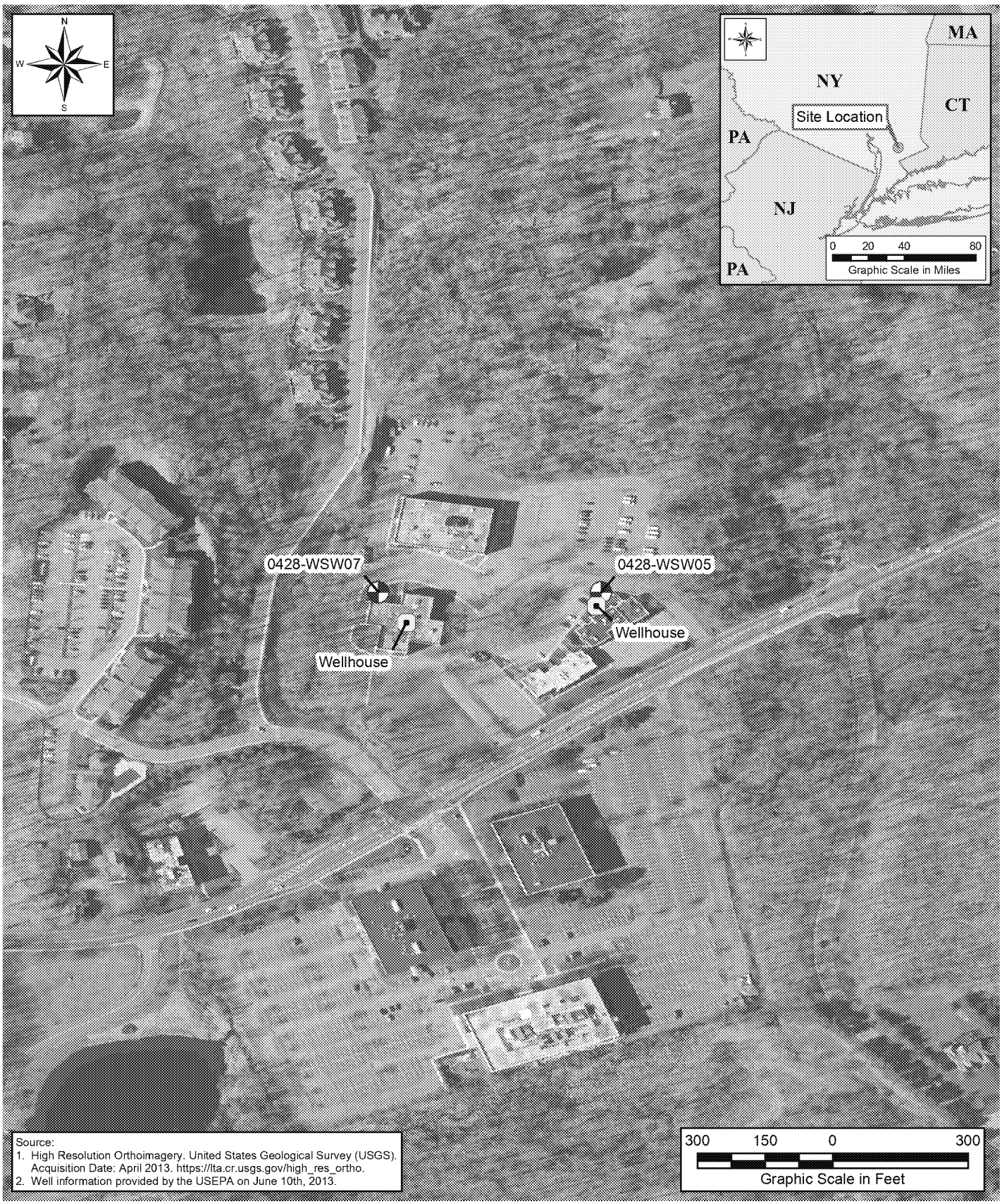
CLIENT NAME: EPA

WESTON SOLUTIONS

DATE: September 2017

FIGURE #: 2B

P:\SAT2\2016 NY RAD Sites\Canadian_Radium_Uranium\MXD\19130_CRU_Sample_Loc_Fig_2B.mxd



LEGEND:

- Wellhouse Location
- Active Non-Transient Non-Community Well Sample Location[2]

TITLE:

Sample Location Map
Northern Westch Professional Park
Site Reassessment
Canadian Radium & Uranium Corp.

PROJECT: Canadian Radium & Uranium Corp.
TDD No. 0004/1611-05

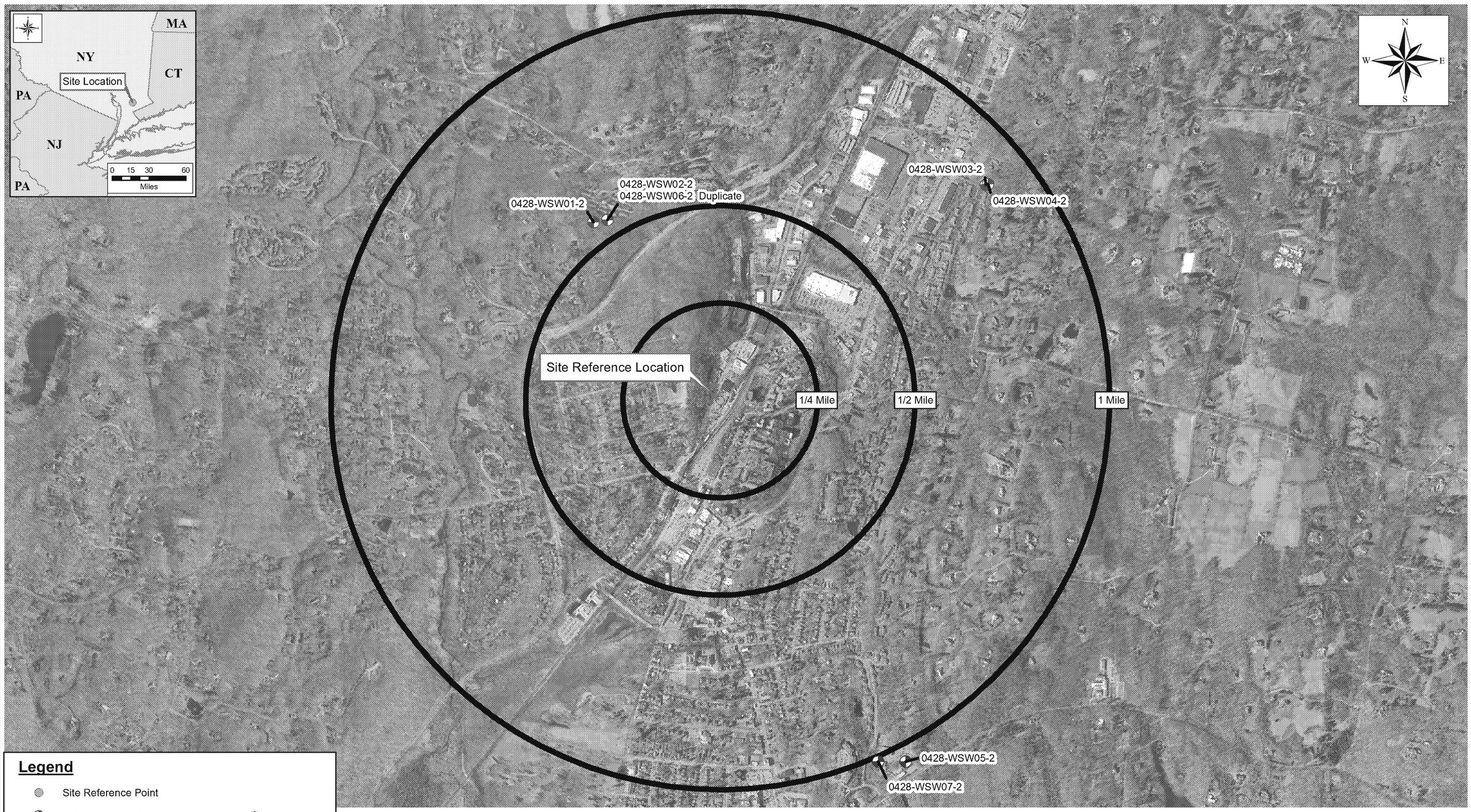
CLIENT NAME: EPA

WESTON SOLUTIONS

DATE: September 2017

FIGURE #: 2C

P:\SAT2\2016 NY RAD Sites\Canadian_Radium_Uranium\MXD\19131_CRU_Sample_Loc_Fig_2C.mxd



Legend

- Site Reference Point
- Active Community Well Sample Location[2]
- Active Non-Transient Non-Community Well Sample Location[2]

SOURCES:

1. Westchester County High Resolution Orthoimage 2013, Sai Pinnepalli, IIC Technologies, Inc, Manager, GIS Services, April 2013.
2. Well information provided by the USEPA on June 10, 2013.
3. U.S Department of the Interior, Fish and Wildlife Service, St. Petersburg, FL. National Wetlands Inventory. http://www.nwi.fws.gov. Date January 1st, 2013.
4. Weston Solutions, Inc. Region 2 Site Assessment Team, Site Logbook, DCN: W0428.3B.01182, December 2016 – June 2017.

SCALE:
1,260 630 0 1,260
Graphic Scale in Feet

PROJECT: Canadian Radium & Uranium Corp.
TDD No. 0004/1611-05

CLIENT NAME: EPA

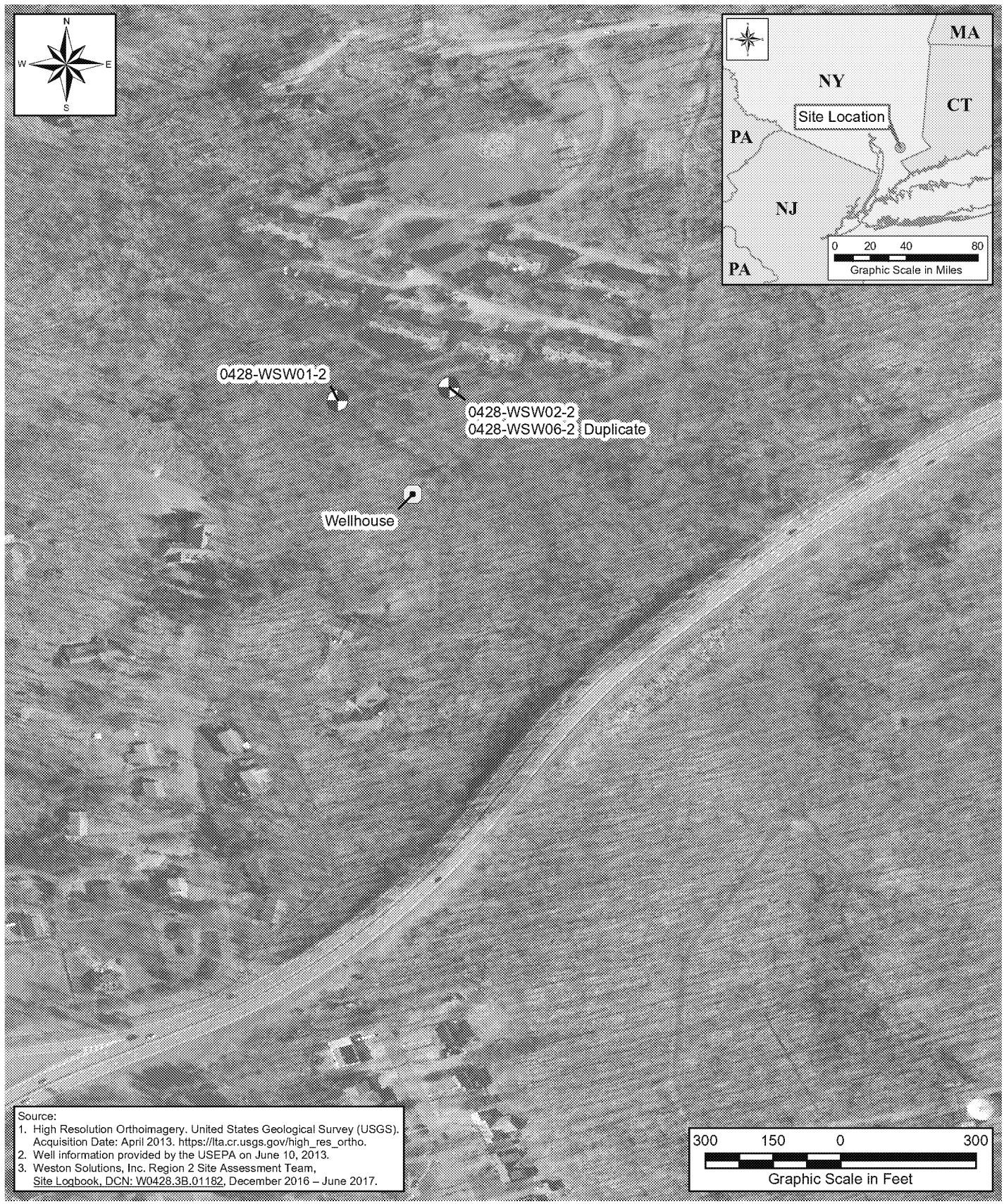
TITLE:
Re-Sampling Location Map – June 2017
Water Supply Well Sampling
Site Reassessment
Canadian Radium & Uranium Corp.

WESTON SOLUTIONS SM

DATE: September 2017

FIGURE #: 3

Document Path: P:\SAT\2016 NY RAD Sites\Canadian_Radium_Uranium\MXD\20463_CRU_Sample_Loc_Resample_Map.mxd



LEGEND:

- Wellhouse Location
- Active Community Well Sample Location(2)

TITLE:

Re-Sampling Location Map
Ramleh Water Works Corp. Inc.
Site Reassessment
Canadian Radium & Uranium Corp.

PROJECT: Canadian Radium & Uranium Corp.
TDD No. 0004/1611-05

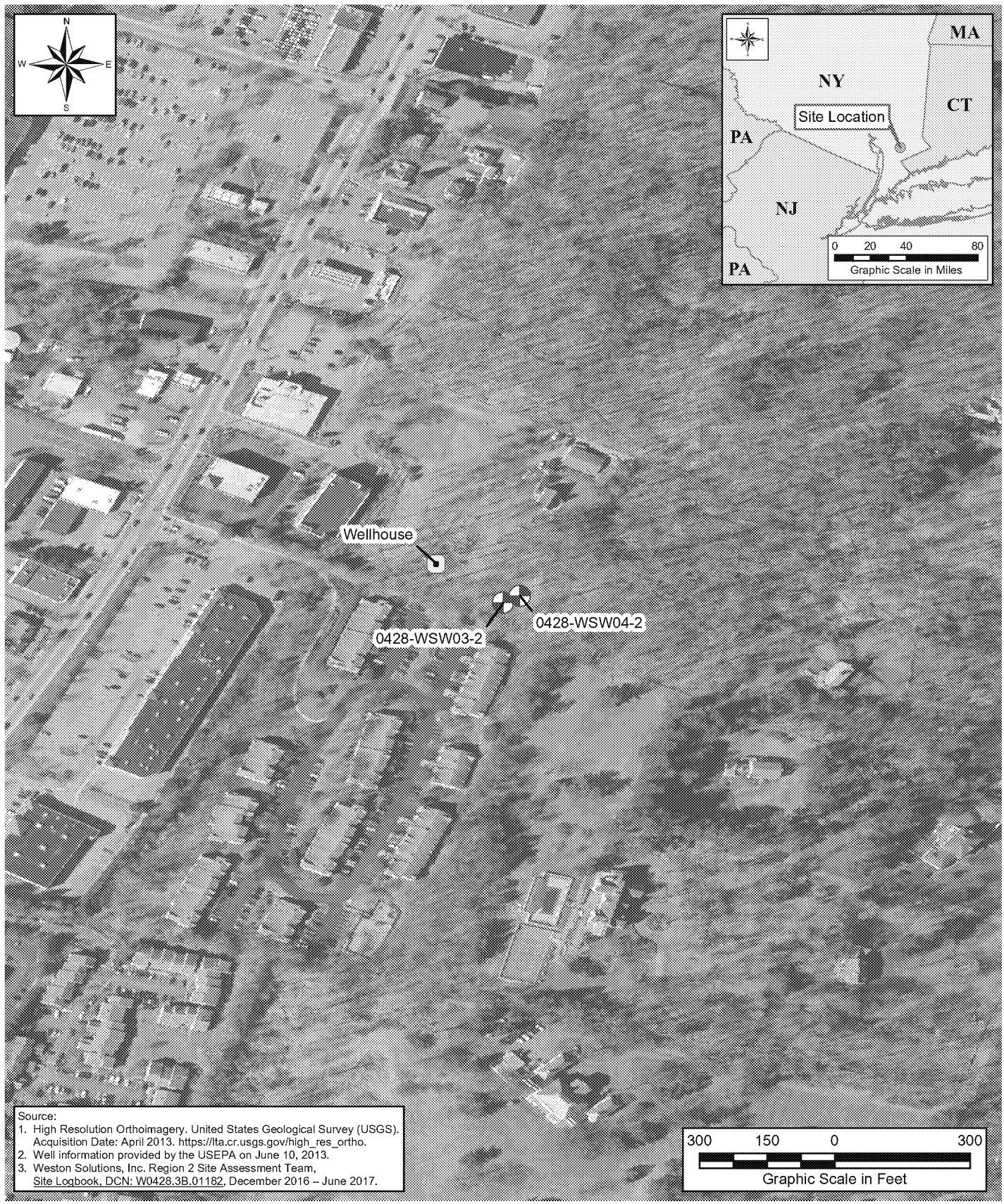
CLIENT NAME: EPA

WESTON SOLUTIONS

DATE: September 2017

FIGURE #: 3A

P:\SAT2\2016 NY RAD Sites\Canadian_Radium_Uranium\MXD\20464_CRU_Sample_Loc_Fig_2A_Resample_Map.mxd



LEGEND:

- Wellhouse Location
- Active Community Well Sample Location[2]

TITLE:

Re-Sampling Location Map
796 Bedford Road Apartments
Site Reassessment
Canadian Radium & Uranium Corp.

PROJECT: Canadian Radium & Uranium Corp.
TDD No. 0004/1611-05

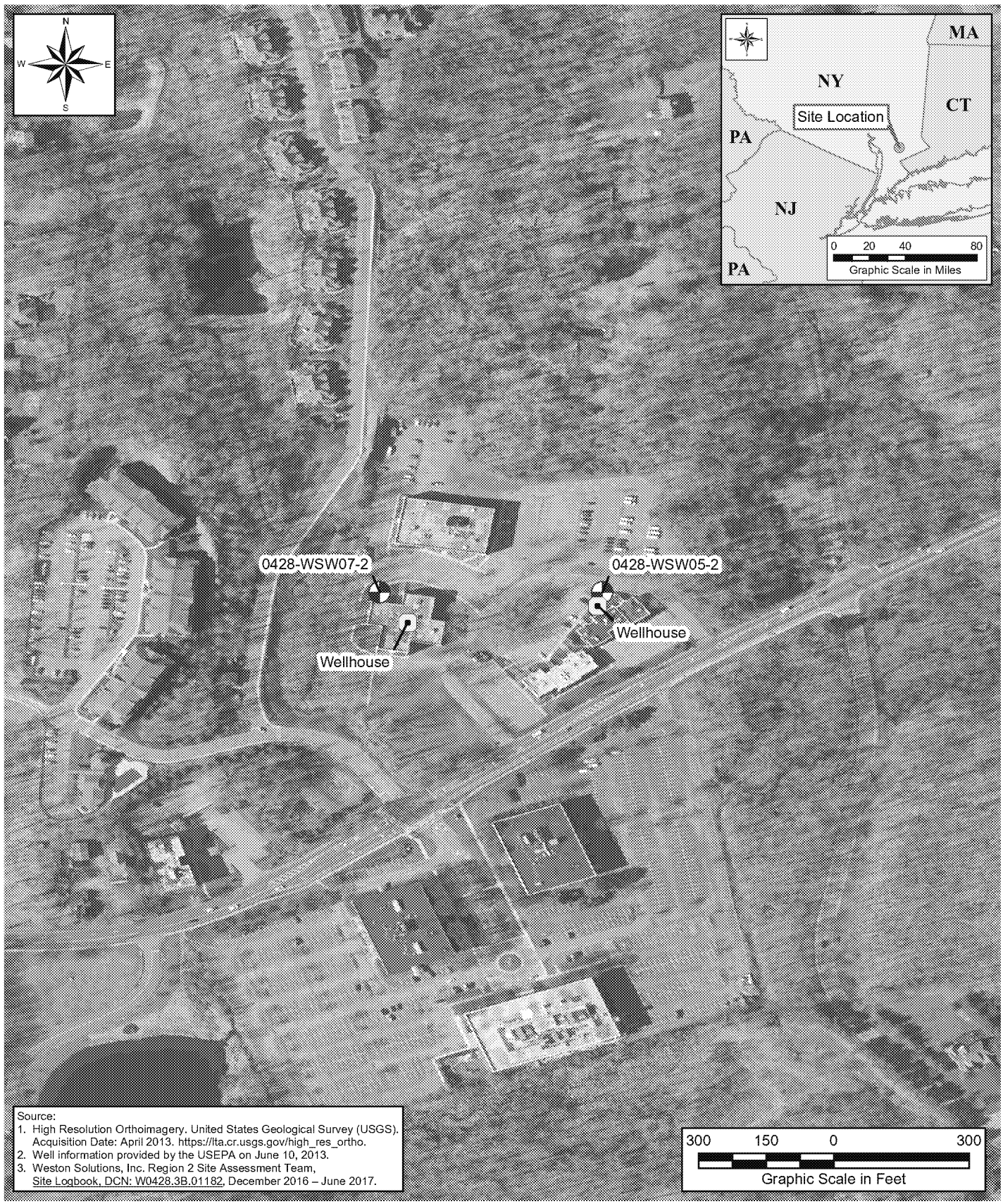
CLIENT NAME: EPA

WESTON SOLUTIONS

DATE: September 2017

FIGURE #: 3B

P:\SAT2\2016 NY RAD Sites\Canadian_Radium_Uranium\MXD\20465_CRU_Sample_Loc_Fig_2B_Resample_Map.mxd



LEGEND:

- Wellhouse Location
- Active Non-Transient Non-Community Well Sample Location[2]

TITLE:

Re-Sampling Location Map
Northern Westch Professional Park
Site Reassessment
Canadian Radium & Uranium Corp.

PROJECT: Canadian Radium & Uranium Corp.
TDD No. 0004/1611-05

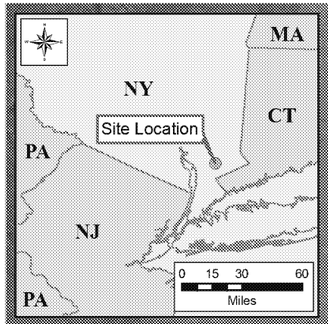
CLIENT NAME: EPA

WESTON SOLUTIONS

DATE: September 2017

FIGURE #: 3C

P:\SAT2\2016 NY RAD Sites\Canadian_Radium_Uranium\MXD\20462_CRU_Sample_Loc_Fig_2C_Resample_Map.mxd



0428-WSW01
0428-WSW02
0428-WSW06 Duplicate
0428-WSW03
0428-WSW04
0428-WSW05
0428-WSW07
Site Reference Location
1/4 Mile
1/2 Mile
1 Mile

Legend

- Site Reference Point
- Active Community Well Sample Location[2]
- Active Non-Transient Non-Community Well Sample Location[2]

Geology

- r — Bedrock.
- og — Outwash sand and gravel: Coarse to fine gravel with sand, proglacial fluvial deposition, well rounded and stratified, generally finer texture away from ice border, permeable, thickness variable (2-20 meters)
- k — Kame deposits: Coarse to fine gravel and/or sand, includes kames, eskers, kame terraces, kame deltas, ice contact, or ice cored deposition, lateral variability in sorting, texture and permeability, may be firmly cemented with calcareous cement, thickness variable (10-30 meters)
- t — Till Variable texture: poorly sorted sand-rich diamict, deposition beneath glacier ice, permeability varies with compaction, thickness variable (1-50 meters)

SOURCES:
1. Westchester County High Resolution Orthoimage 2013, Sai Pinnepalli, IIC Technologies, Inc, Manager, GIS Services, April 2013.
2. Well information provided by the USEPA on June 10th, 2013.
3. U.S Department of the Interior, Fish and Wildlife Service, St. Petersburg, FL. National Wetlands Inventory. http://www.nwi.fws.gov. Date January 1st, 2013.
4. Integrated Geologic Map Databases for the United States: Delaware, Maryland, New York, Pennsylvania, and Virginia Edition: version 1.0 - U.S. Geological Survey, 2005.

SCALE: 1,260 630 0 1,260 Graphic Scale in Feet

PROJECT: Canadian Radium & Uranium Corp. TDD No. 0004/1611-05

CLIENT NAME: EPA

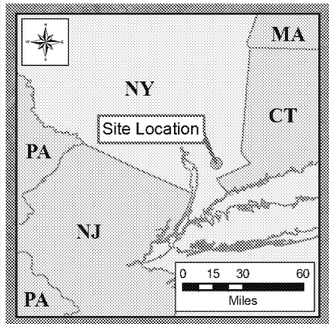
TITLE: Surficial Geology Map Canadian Radium & Uranium Corp.

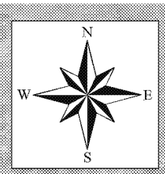
WESTON SOLUTIONS SM

DATE: September 2017

FIGURE #: 4

Document Path: P:\SAT\2016 NY RAD Sites\Canadian_Radium_Uranium\MXD\19960_CRU_Surficial_Geology_Map.mxd





0428-WSW01
0428-WSW02
0428-WSW06 Duplicate
0428-WSW03
0428-WSW04
0428-WSW05
0428-WSW07

Site Reference Location

1/4 Mile
1/2 Mile
1 Mile

fc
OCi
f

Legend

- Site Reference Point
- Active Community Well Sample Location(2)
- Active Non-Transient Non-Community Well Sample Location(2)

Geology

- f — Fordham Gneiss, Undivided (Precambrian - Middle Proterozoic)
- fc — Fordham Gneiss (C and D member) (Precambrian - Middle Proterozoic)
- OCi — Inwood Marble (Early Cambrian - Lower Ordovician)

NOTES:
1. Fordham Gneiss, undivided: fe: garnet-biotite-quartz-plagioclase gneiss, and amphibolite;
   fd: sillimanite-garnet schistose gneiss, quartzite;
   fc: biotite-hornblende-quartz-plagioclase gneiss, quartz-feldspar lenses, amphibolite, biotite and/or hornblende-quartz-feldspar gneiss;
   fb: amphibolite, biotite and/or hornblende-garnet-quartz-plagioclase gneiss;
   fa: garnet-biotite-quartz-plagioclase gneiss, amphibolite, biotite-hornblende-quartz-plagioclase gneiss, quartz-feldspar granulite.

SOURCES:
1. Westchester County High Resolution Orthoimage 2013,
   Sai Pinnepalli, IIC Technologies, Inc, Manager, GIS Services, April 2013.
2. Well information provided by the USEPA on June 10th, 2013.
3. Integrated Geologic Map Databases for the United States:
   Delaware, Maryland, New York, Pennsylvania, and Virginia Edition: version 1.0 - U.S. Geological Survey, 2005.

SCALE:
1,260 630 0 1,260
Graphic Scale in Feet

PROJECT:
Canadian Radium & Uranium Corp.
TDD No. 0004/1611-05

CLIENT NAME:
EPA

TITLE:
Bedrock Geology Map
Canadian Radium & Uranium Corp.

WESTON SOLUTIONS SM

DATE:
September 2017

FIGURE #:
5

Document Path: P:\SAT\2016 NY RAD Sites\Canadian_Radium_Uranium\MXD\19962_CRU_Bedrock_Geology_Map.mxd

TABLES

TABLE 1 **DCN: W0428.1A.01313**
WATER-SUPPLY-WELL SAMPLE LOCATIONS
CANADIAN RADIUM AND URANIUM CORP. – SITE REASSESSMENT

Public Water System ID	Water System Well Name	Sample ID	Latitude (decimal degrees)	Longitude (decimal degrees)	Approx. Ground Surface Elevation (ft ± MSL)
NY5922912	Deer Ridge Well 1	0428-WSW01	41.2189310	-73.7334740	420
	Deer Ridge Well 2	0428-WSW02 0428-WSW06 (DUP)	41.2190110	-73.7327970	400
NY5930069	Bedford Rd Apts Well 1	0428-WSW03	41.2201790	-73.7141160	440
	Bedford Rd Apts Well 2	0428-WSW04	41.2202210	-73.7140140	440
NY5922308	NWPP 101	0428-WSW05	41.1987500	-73.7183350	370
NY5930006	NWPP 103-105	0428-WSW07	41.1987490	-73.7196910	360

Notes:
1. Water system NY5922912 is listed as "Ramleh Water Works Corp. Inc." in EPA's Safe Drinking Water Information System (SDWIS).
2. Water system NY5930069 is listed as "796 Bedford Road Apartments" in SDWIS.
3. NWPP = Northern Westchester Professional Park

TABLE 2
WATER-SUPPLY-WELL ANALYTICAL RESULTS – DECEMBER 2016 (PHASE 1)
CANADIAN RADIUM AND URANIUM CORP. – SITE REASSESSMENT

DCN: W0428.1A.01313

Location:	Bedford Rd Apts Well 1				Bedford Rd Apts Well 2				Criteria for Significance above Background			Deer Ridge Well 1				Deer Ridge Well 2								NWPP 101				NWPP 103-105								HRS Benchmarks	
Field Sample ID:	0428-WSW03				0428-WSW04							0428-WSW01				0428-WSW02				0428-WSW06				0428-WSW05				0428-WSW07									
Date:	12/6/2016				12/6/2016							12/6/2016				12/6/2016				12/6/2016				12/6/2016				12/6/2016									
Comments:	Site-Specific Background (SSBG)				Site-Specific Background (SSBG)				Mean SSBG	Max. 2S	Mean SSBG + Max. 2S	–								Field Duplicate of 0428-WSW02								Laboratory Duplicate Samples								Minimum Value	Source
Radioisotope	Result	Q	2S	MDC	Result	Q	2S	MDC				Result	Q	2S	MDC	Result	Q	2S	MDC	Result	Q	2S	MDC	Result	Q	2S	MDC	Result	Q	2S	MDC	Result	Q	2S	MDC		
Bismuth-212 (Bi-212)	0.25	U	7.92	13.4	-0.64	U	23.7	12.0	-0.2	23.7	23.5	-0.25	U	43.9	12.7	1.35	U	7.48	12.6	-0.35	U	13.9	12.5	-0.27	U	58.0	12.4	-0.35	U	3980	12.1	0.78	U	7.04	11.9	n/a	n/a
Bismuth-214 (Bi-214)	0.24	UJ	1.23	2.16	0.61	UJ	1.08	1.69	0.43	1.23	1.66	4.87	J	1.42	1.81	1.43	UJ	1.21	1.78	-0.24	UJ	1.32	1.71	0.03	UJ	1.20	1.84	-0.17	UJ	1.31	1.76	0.40	UJ	1.26	1.86	n/a	n/a
Cesium-137 (C-s137)	0.13	U	0.54	0.92	-0.09	U	0.48	0.82	0.02	0.54	0.56	-0.12	U	0.60	1.00	-0.14	U	0.58	0.97	-0.44	U	0.61	1.00	0.13	U	0.53	0.90	0.02	U	0.57	0.96	-0.20	U	0.56	0.94	1.71	CRSC
Lead-210 (Pb-210)	-2.80	U	18.8	22.0	2.77	U	11.5	18.1	0.0	18.8	18.8	-4.14	U	23.2	22.4	-4.46	U	24.4	22.4	-0.35	U	13.3	21.6	-0.58	U	13.7	21.6	-2.74	U	18.9	22.2	1.37	U	12.7	21.6	0.0411	CRSC
Lead-212 (Pb-212)	0.80	U	1.08	1.78	0.92	U	1.10	1.80	0.86	1.10	1.96	0.91	U	1.13	1.85	0.72	U	1.11	1.83	0.80	U	1.08	1.77	1.26	U	1.10	1.79	1.06	U	1.09	1.79	1.78	--	1.00	1.42	n/a	n/a
Lead-214 (Pb-214)	0.74	UJ	1.45	2.09	0.12	UJ	1.36	2.34	0.43	1.45	1.88	3.52	J	1.45	2.01	0.60	UJ	1.41	2.40	-0.44	UJ	2.30	2.36	-0.52	UJ	2.53	2.33	-0.64	UJ	2.92	2.30	-0.40	UJ	2.11	2.27	n/a	n/a
Potassium-40 (K-40)	-9.82	U	23.1	11.3	-3.34	U	8.69	11.0	-6.6	23.1	16.5	5.40	U	8.82	11.1	3.41	U	8.13	10.8	4.15	U	8.73	11.0	6.94	U	7.35	9.98	7.19	U	7.97	10.2	5.70	U	7.63	10.3	n/a	n/a
Radium-226 (Ra-226)	0.65	J	0.23	0.13	0.65	J	0.22	0.12	0.65	0.23	0.88	**1.07**	J	0.30	0.13	**1.14**	J	0.35	0.12	0.31	J	0.15	0.10	0.56	J	0.20	0.12	0.38	J	0.18	0.14	0.51	J	0.20	0.12	0.135	CRSC
Radium-228 (Ra-228)	1.81	U	1.98	3.24	2.19	U	1.92	3.10	2.00	1.98	3.98	3.38	--	2.02	3.16	2.39	U	2.04	3.28	2.85	U	2.05	3.26	2.51	U	1.98	3.18	1.95	U	1.87	3.02	0.86	U	1.85	3.08	0.0502	CRSC
Total Radium (calculated)	2.46		2.21		2.84		2.14		2.65	2.21	4.86	4.45				3.53				3.16				3.07				2.33				1.37				n/a	n/a
Thallium-208 (Tl-208)	0.06	U	0.59	1.02	-0.10	U	0.81	1.00	-0.02	0.81	0.79	-0.17	U	1.08	1.01	-0.14	U	1.00	1.03	-0.26	U	1.54	0.98	0.02	U	0.58	1.01	-0.06	U	0.70	1.00	0.00	U	0.58	1.01	n/a	n/a
Thorium-227 (Th-227)	0.00	U	0.09	0.22	-0.01	U	0.05	0.14	-0.01	0.09	0.09	-0.01	U	0.06	0.16	0.08	U	0.11	0.13	-0.01	U	0.06	0.15	0.02	U	0.08	0.16	0.00	U	0.08	0.19	0.00	U	0.05	0.13	1.08	CRSC
Thorium-228 (Th-228)	0.08	U	0.08	0.10	0.10	U	0.09	0.11	0.09	0.09	0.18	0.17	--	0.12	0.15	0.01	U	0.07	0.14	0.12	U	0.10	0.14	0.16	--	0.12	0.13	0.07	U	0.08	0.11	0.00	U	0.07	0.15	0.1	CRSC
Thorium-230 (Th-230)	0.13	U	0.17	0.28	0.00	U	0.14	0.27	0.07	0.17	0.24	0.01	U	0.14	0.28	0.18	U	0.17	0.27	0.09	U	0.16	0.27	0.07	U	0.15	0.27	0.05	U	0.15	0.27	0.09	U	0.15	0.27	0.571	CRSC
Thorium-232 (Th-232)	0.02	U	0.06	0.11	0.00	U	0.03	0.08	0.01	0.06	0.07	-0.02	U	0.04	0.12	0.03	U	0.05	0.08	0.00	U	0.03	0.07	0.01	U	0.04	0.09	0.04	U	0.06	0.07	0.00	U	0.05	0.11	0.517	CRSC
Thorium-234 (Th-234)	1.50	U	15.5	25.8	-0.14	U	15.1	25.2	0.7	15.5	16.2	7.26	U	15.9	26.3	-10.3	U	14.5	23.9	4.89	U	15.5	25.7	11.9	U	14.0	23.0	0.36	U	15.0	25.0	2.92	U	13.9	23.1	2.26	CRSC
Uranium-234 (U-234)	0.20	--	0.11	0.10	0.06	U	0.07	0.11	0.13	0.11	0.24	0.16	--	0.10	0.09	0.32	--	0.17	0.14	0.37	--	0.15	0.08	**1.88**	--	0.37	0.10	0.43	--	0.16	0.09	0.26	--	0.16	0.20	0.739	CRSC
Uranium-235 (U-235)	0.09	U	0.09	0.11	0.01	U	0.05	0.11	0.05	0.09	0.14	0.02	U	0.05	0.09	0.03	U	0.09	0.16	0.03	U	0.06	0.08	0.10	U	0.09	0.10	0.06	U	0.08	0.10	0.01	U	0.09	0.19	0.727	CRSC
Uranium-238 (U-238)	0.09	U	0.08	0.10	0.13	--	0.09	0.07	0.11	0.09	0.20	0.16	--	0.10	0.09	0.22	--	0.14	0.10	0.24	--	0.12	0.07	**1.32**	--	0.30	0.09	0.20	--	0.12	0.10	0.22	--	0.13	0.15	0.60	CRSC
Gross Alpha	1.17	U	4.17	3.32	4.82	--	4.82	3.25	3.00	4.82	7.82	3.45	U	5.39	3.78	4.11	U	6.23	4.26	1.81	UJ	7.61	5.89	6.10	UJ	20.5	16.0	-0.78	UJ	7.89	6.90		n/a			n/a	n/a
Gross Alpha (lab dup.)		n/a				n/a				n/a		3.47	U	5.58	4.31		n/a				n/a				n/a				n/a				n/a			n/a	n/a
Gross Beta	7.42	--	3.26	4.34	7.00	--	3.22	4.33	7.21	3.26	10.5	12.1	--	3.60	4.46	11.2	--	3.47	4.36	12.2	--	6.29	8.65	8.36	UJ	11.2	16.5	4.91	UJ	5.27	7.57		n/a			n/a	n/a
Gross Beta (lab dup.)		n/a				n/a				n/a		9.3	--	3.32	4.31		n/a				n/a				n/a				n/a				n/a			n/a	n/a

All sample results are reported in picocuries per liter (pCi/L).
Column Q is defined as the final data validator qualifier.
Column 2S is defined as the total uncertainty in the result (i.e., 2 standard deviations).
Column MDC is defined as the minimum detectable concentration.
U = The reported value is below the MDC and is considered to be a non-detect result.
UJ = The reported value is below the achievable MDC and is considered to be a non-detect result, but the required MDC was not attained.
J = The result is an estimated quantity.
YELLOW HIGHLIGHT Indicates measured unadjusted concentrations above MDCs which also equal or exceed a value 2 standard deviations above the mean site-specific background cocentration.
BOLDFACE TYPE Indicates unadjusted detections 2 standard deviations above background that also exceed the HRS Level I benchmark.

TABLE 3
WATER-SUPPLY-WELL ANALYTICAL RESULTS – PHASE 2 SAMPLING (jUNE 2017)
CANADIAN RADIUM AND URANIUM CORP. – SITE REASSESSMENT

Location:	Bedford Rd Apts Well 1				Bedford Rd Apts Well 2				Criteria for Significance above Background *			Deer Ridge Well 1				Deer Ridge Well 2								NWPP 101				NWPP 103-105				HRS Benchmarks	
Field Sample ID:	0428-WSW03-02				0428-WSW04-02							0428-WSW01-02				0428-WSW02-02				0428-WSW06-02				0428-WSW05-02				0428-WSW07-02					
Date:	6/28/2017				6/28/2017							6/27/2017				6/27/2017				6/27/2017				6/27/2017				6/27/2017					
Comments:	Site-Specific Background (SSBG)				Site-Specific Background (SSBG)				Mean SSBG	Max. Unc.	Comparison Criteria	–								Field Duplicate of 0428-WSW02-02											Minimum Value	Source
Radioisotope	**Result**	**Q**	**Unc.**	**MDC**	**Result**	**Q**	**Unc.**	**MDC**				**Result**	**Q**	**Unc.**	**MDC**	**Result**	**Q**	**Unc.**	**MDC**	**Result**	**Q**	**Unc.**	**MDC**	**Result**	**Q**	**Unc.**	**MDC**	**Result**	**Q**	**Unc.**	**MDC**		
Potassium (ug/L)	3,870		n/a	500	4,010		n/a	500	4,010	n/a	12,030	6,210		n/a	500	4,650		n/a	500	4,640		n/a	500	12,200		n/a	500	5,880		n/a	500	n/a	n/a
Radon (pCi/L)	1,491		274	46.3	1,108		206	46.3	1,299.5	274	1573.5	369.1		79.6	53.3	793		153	53.6	772		149	55.1	1,675		309	56.0	1,949		358	55.8	n/a	n/a
Radium-226 (pCi/L)	0.519		0.279	0.101	0.677		0.331	0.108	0.598	0.331	0.929	0.503		0.253	0.0853	0.271	0.3UJ	0.191	0.0919	0.815	J	0.369	0.110	0.364		0.219	0.0897	0.594		0.299	0.101	0.135	CRSC
Radium-228 (pCi/L)	0.960		0.438	0.732	1.42		0.503	0.723	1.19	0.503	1.693	1.37		0.516	0.772	0.475		0.336	0.647	0.0758		0.285	0.645	**1.93**		0.573	0.694	0.535		0.396	0.774	0.0502	CRSC
Total Radium (pCi/L; calculated)	1.479		0.717	0.833	2.097		0.834	0.831	1.788	0.834	2.622	1.873		0.769	0.8573	0.746		0.527	0.7389	0.8908		0.654	0.755	2.294		0.792	0.7837	1.129		0.695	0.875	n/a	n/a
Total Uranium (ug/L)	0.282		0.009	0.193	0.177		0.007	0.193	0.2295	0.009	0.6885	0.192		0.007	0.193	0.188	J	0.006	0.193	0.235	J	0.008	0.193	**4.26**		0.106	0.193	0.816		0.024	0.193	4	NCRSC
Uranium-234 (pCi/L)	0.224		0.171	0.241	0.250		0.166	0.227	0.237	0.171	0.408	0.246		0.158	0.143	0.237	J	0.168	0.143	0.083	J	0.108	0.206	**1.63**		0.427	0.102	0.605		0.242	0.167	0.739	CRSC
Uranium-235 (pCi/L)	0.231		0.174	0.089	0.057		0.097	0.134	0.144	0.174	0.318	0.115		0.122	0.153	0.133		0.156	0.249	0.048		0.101	0.146	0.190		0.142	0.072	0.048		0.097	0.135	0.727	CRSC
Uranium-238 (pCi/L)	0.019		0.091	0.126	0.057		0.074	0.102	0.038	0.091	0.129	0.213		0.147	0.139	0.101		0.115	0.170	0.049		0.079	0.156	**1.22**		0.356	0.102	0.208		0.136	0.123	0.60	CRSC
Gross Alpha (pCi/L)	2.82		0.761	0.628	3.63		0.972	0.919	3.225	0.972	4.197	1.92		0.750	0.914	0.994		0.441	0.610	0.723		0.402	0.618	8.82		3.75	5.17	4.19		2.29	2.97	n/a	n/a
Gross Beta (pCi/L)	3.32	J+	0.750	0.602	3.59	J+	0.801	0.624	3.455	0.801	4.256	3.23	J+	0.900	1.04	2.76	J+	0.664	0.640	3.21	J+	0.718	0.568	6.46	J+	2.59	3.80	2.77	J+	1.19	1.74	n/a	n/a

* For radionuclides, the criterion for significance above background = mean site-specific background + highest uncertainty (2 standard deviations). For Potassium and Total Uranium, the criterion for significance above background = 3x maximum background.
Column Q is defined as the final data validator qualifier.
Column Unc. is defined as the total uncertainty in the result (i.e., 2 standard deviations).
Column MDC is defined as the minimum detectable concentration.
YELLOW HIGHLIGHT Indicates unadjusted measured concentrations which also equal or exceed a value 2 standard deviations above the mean site-specific background cocentration.
BOLDFACE TYPE Indicates unadjusted detections above background that also exceed the HRS Level I benchmark.